

ABSTRACT

The Afognak Lake sockeye salmon *Oncorhynchus nerka* run severely declined in 2001 and has remained low since. Concerns expressed by local subsistence users to the Alaska Department of Fish and Game and the US Fish and Wildlife Service Office of Subsistence Management prompted an investigation of the lake's rearing environment in 2003 followed by subsequent annual studies. This report provides 2009 project results, a summary of results from 2007 and 2008, and an evaluation of limnology conditions and their effects upon smolt production. Using mark-recapture techniques, it was estimated that 492,998 sockeye salmon smolts (95% CI 417,689 – 568,306) emigrated from Afognak Lake in 2009. The population was estimated to be composed of 427,141 age-1., 64,560 age-2., and 1,296 age-3. smolts. Age-1. smolts had a mean weight of 3.5 g, a mean length of 76.7 mm, and a mean condition factor of 0.76. Age-2. smolts had a mean weight of 5.3 g, a mean length of 88.8 mm, and a mean condition factor of 0.75. Age-3. smolts had a mean weight of 6.6 g, a mean length of 94.0 mm, and a mean condition factor of 0.80. Lake limnology data was collected during five monthly sampling events from May to September in 2009. Compared to 2003-2008 limnology records notable 2009 results included an increase in chlorophyll-*a* concentrations, a continued trend of reduced total phosphorus concentrations, a historical low zooplankton density, and a positive association ($p < .005$, $R^2 = .818$) between temperature and the condition of emigrating smolts. Further assessment of photosynthetically active radiation, nutrient availability, phytoplankton population, available forage species vs. actual forage species, and the bioenergetic responses of juvenile salmon will occur over the next four years (2010-2013). This additional information, coupled with annual smolt health and abundance estimates, will provide greater insight into Afognak Lake's freshwater environment and factors affecting smolt production.

Key words: Afognak Lake, Litnik, mark-recapture, age, emigration, escapement, Kodiak Island, *Oncorhynchus nerka*, smolt, sockeye salmon, subsistence harvest, trap, zooplankton.